Institute of
Engineering Thermodynamics

INSIDE –
In-situ Diagnostics in Water Electrolysers

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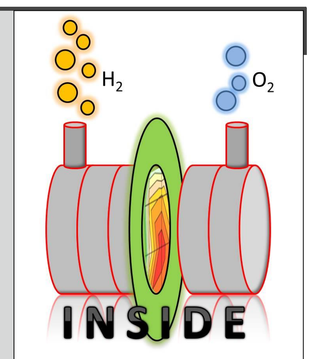


Objectives

An electrochemical in-situ diagnostics tool for monitoring of locally resolved current densities, originally developed for application in PEM fuel cells, is adapted to water electrolysis:

- PEMWE: based on proton exchange membranes
- AWE: alkaline water electrolysis
- AEMWE: based on anion exchange membranes

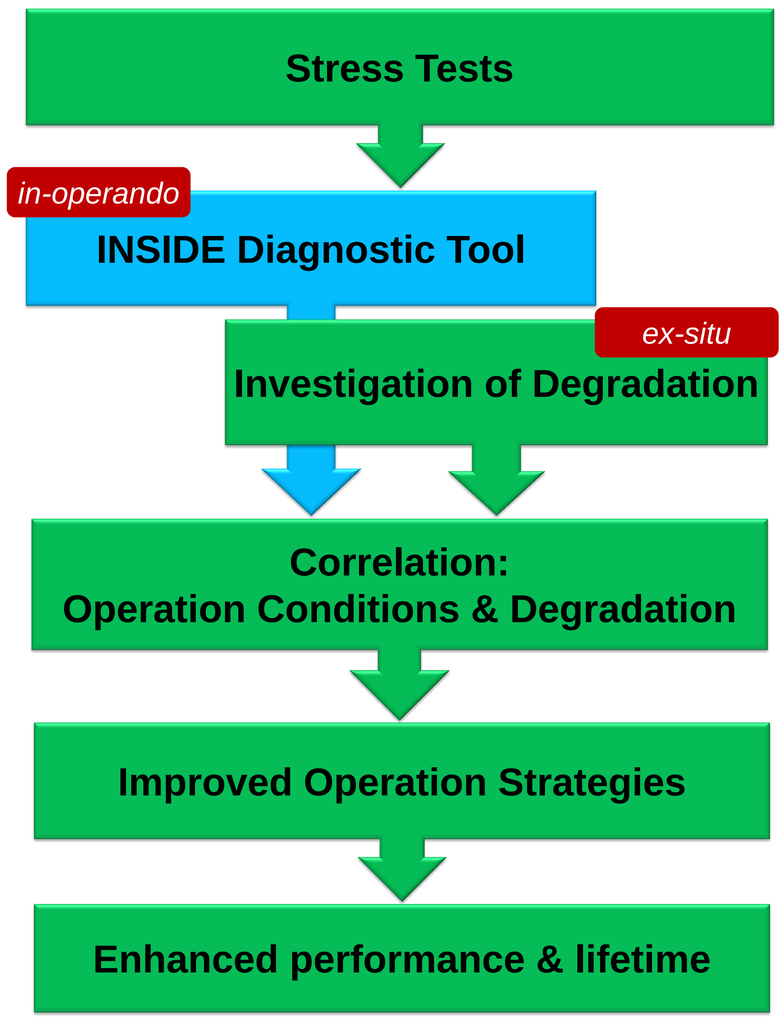
The developed tools allow to correlate performance issues and ageing processes with local anomalies. Corresponding mechanisms are investigated with ex-situ analytics.

Partners

- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Stuttgart, Germany (Coordinator)
- NEL Hydrogen AS, Notodden, Norway
- Heliocentris Italy S.r.l., Crespina, Italy
- Centre National de la Recherche Scientifique, France
- Université de Strasbourg, Strasbourg, France
- Hochschule Esslingen, Esslingen, Germany

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for Fuel Cell and Hydrogen Joint Technology Initiative under Grant No. 621237 (INSIDE).

Strategy



Perspectives

The patented segmented printed circuit board (PCB) for the monitoring of current density distributions in PEM based fuel cells is used and steadily improved at DLR.

- Monitoring of performance and local anomalies during operation
- Revealing systematical deficiencies not detectable offline
- Correlating degradation mechanisms and system parameters
- Identifying and preventing critical operation
- Systematically improving the efficiency of water electrolysis
- Recommendations for use of present and for design of future water electrolysers

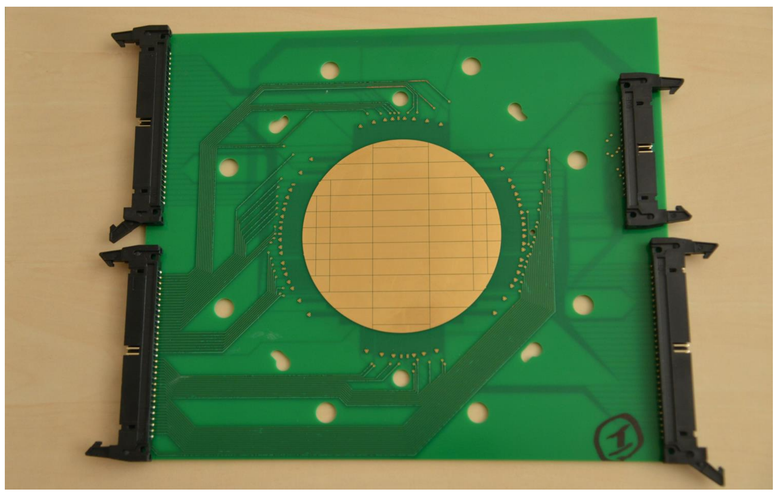
Challenges

Adaptation of segmented PCB:

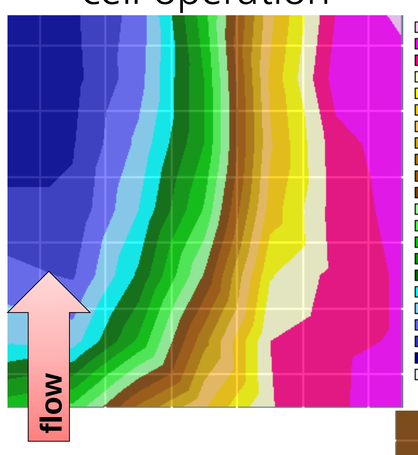
- pH and non H^+ ions
- Pressure
- Bubble formation
- Sealing

Achievements

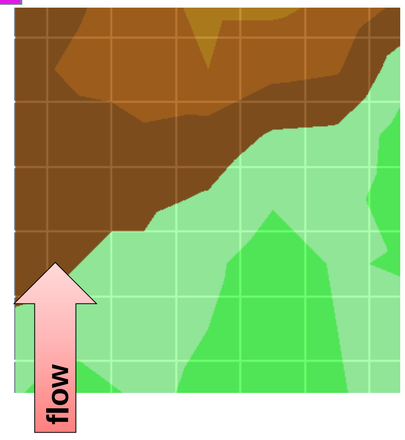
- AEMWE: Prototype delivered



- PEMWE: Technology concept in test cell operation



Visualisation of water starvation



Irreversible degradation – correlated to other metal ion poisoning

- Operando Electrochemical ambient pressure XPS cell for degradations studies
(Saveleva et al, J Phys Chem C 2016, 120, 15930)

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